

Pretend sign created during collective family play: A cultural-historical study of a child's scientific learning through everyday family play practices

Yijun Hao

Monash University, Australia

Marilyn Fleeer

Monash University, Australia

Abstract

Based on a cultural-historical perspective, where play is conceptualized as the creation of an imaginary situation, the study reported in this paper examines how parent–child playful interactions create shared imaginary situations for mediating scientific learning. The main focus of this paper is to reveal sign-mediated learning process through collectively participated family imaginary play. This study draws upon part of a broader research project, and in this paper we will focus on one 3-year-old child and his parents from a medium-sized city in Mainland China. The findings reveal that during collective family engagement, the pretend signs were not predetermined but were created, updated, and developed through sustained shared imaginary situations between parents and the child. A child's scientific learning is supported and mediated as the pretend signs were formed and embedded with social meanings during parent–child play where the child's reimagining of certain scientific phenomenon occurs. In this paper it is argued that a child's playful learning can be analyzed as he or she is involved in the social practice of family play where the process of internal changes during reimagining appear as a form of self-regulation.

Keywords

Early childhood education; cultural-historical; play; sign; family; scientific learning

Introduction

Over the past three decades, there has been an increasing trend in exploring how play is in relation to learning and development (e.g., Falco, Esposito, Venuti, & Bornstein, 2010; Samuelsson & Calsson, 2008). However, much of this research has theorized play from a developmental point of view (e.g., Roopnarine, 2011) that formulates predetermined stages, such as play with objects, social play, and then symbolic play (e.g., Fromberg & Bergen, 2006), where the developmental stage of the child determines what kinds of play he/she may engage in. These developmental theories conceptualize play as internally driven, which means play is drawing upon the developed skills or abilities in early years and brings together what children have already learned, experienced, and understood (Bruce, 2005).

However, theories of play that are framed as natural and intrinsic to the child cannot help with understanding the developmental and learning nature of play. For example, how new play forms are learned and developed during everyday family practices in fostering a child's scientific learning. Recent research has shown that play could be pedagogically formed and used in supporting the development and learning in the early childhood period (e.g., Trawick-Smith, 2009, 2012), and the new pedagogical modes that use play result in changes to children's learning processes (e.g., Gustavsson & Pramling, 2014; Ljung-Djårf, Magnusson, & Peterson, 2014). Evidence also shows the diversity of children's learning experiences when play was learned and introduced differently in families (Gaskins, Haight, & Lancy, 2007; Hedegaard & Fler, 2013; Ugaste, 2005).

In terms of the crucial role of play in mediating young children's learning and thinking, it has been demonstrated that, through play as the "learning medium", young children are able to explore their surroundings, practice social rules, and acquire new knowledge (Bergen, 2009; Elkind, 2008; Pelegrini, 2009). However, the empirical evidence concerning the mediating process of play in facilitating the development of concepts especially scientific concepts by children in early years is limited. One possible reason is that such concepts are excluded in early childhood education because of a belief that they are too complicated for preschoolers to acquire (Cunningham, Zibulsky, & Callahan, 2009; Thulin & Helldén, 2011). Vygotsky (1997a) has argued that the process of scientific learning is usually depicted and analyzed based on educationally arranged stages and as such, we miss the very essence of learning from a psychological pathway. That is, a child's development of scientific thinking is shown within a sign-mediated process rather than unfolding in predictable forms along a common lifespan.

Play has been revealed recently as an important pedagogical tool included in the teaching modes for promoting preschool science learning (e.g., Anastasiou, Kostaras, Kyritsis, & Kostaras, 2015; Gustavsson & Pramling, 2014), which is also evident in providing the idea of providing the appropriate scientific learning environment (Anastasiou et al., 2015). However, what has been missing from this research is a comprehensive study of how play is formed in informal settings, such as playgroups, kindergartens (Siry & Kremer, 2011), and family homes (Sikder & Fler, in press) in considering very young children's scientific learning. Additionally, the nature of play in mediating young children's learning process when thinking with scientific concepts has not been fully researched; there is little acknowledgement of how the essence and nature of play contributes to children's learning so as to support scientific concept formation.

This article draws upon the cultural-historical concepts of play and development as conceptualized by Vygotsky (2005, this issue), to examine the role of collective play in mediating young children's scientific learning in the context of the family home. A cultural-historical

perspective provides a new lens to see play. This viewpoint draws upon the explanation that cultural experiences and social interactions of children build diversity and complexity in play activities, which in turn, broaden their historical or social experiences. This theoretical understanding challenges the traditional developmental view that play is based on the maturation of internal abilities (e.g., Bruce, 2005; Dockett, 1999; Kennedy & Barblett, 2010; Moyles, 2005), and focuses more on the dialectical relations between the internal landscape and the external experiences (Bozhovlch, 2009; Vygotsky, 1994). When play is theorized as a form of social interactions rather than as a maturational sequence, learning, mediation, and development can be conceptualized within family play practices.

In drawing upon the cultural-historical concepts of play, such as event representation in play (Bretherton, 1984), the learning nature of play (van Oers, 1999, 2013) and collective imaginary situation (Fleer, 2010, 2013), this paper goes one step further by examining sign as embedded in collectively imaginary play when a child's scientific learning is taken into account. As the sign feature of play is considered, the mechanism of playful learning might be better revealed within everyday family play settings. Therefore, this paper is designed to answer the following questions:

- 1) In collective family play situations, how are pretend signs created?
- 2) How is a child's scientific learning mediated through his or her family play practices?

A cultural-historical theorization of sign mediation

Based on a cultural-historical perspective, the development of human forms of mental functions is seen as a sign-mediated process (Vygotsky, 1997a). For human beings, the tool serves as a means of directing the changes outward; however, the sign is primarily a social means, a kind of "psychological tool" (Vygotsky, 1997b, p. 85), and "a mediator of social relationships" (Davydov, 2008, p. 180), which directs the changes inward. In terms of the sign-mediated process, Vygotsky (1997c) identifies two types of internalization: "first, the processes of mastering external materials of cultural development and thinking: language, writing, arithmetic, drawing; second, the process of development of special higher mental functions" (p. 14; see Figure 1). These two lines are dialectically related to each other.

There exists a new plane at a critical moment of problem operation when a child appeals for help, which shows the inclination to include "a social element into his [sic] action and thereby determines that action's fate and the future path of development of his behaviour" (Vygotsky & Luria, 1994, p. 116). The child's activities are in the situation of acquiring the social meaning, which is featured in a new route leading to the refraction through a "social thought" (Vygotsky & Luria, 1994). It has been argued that every sign-mediated behavior is originally "a social form of co-operation" and continuously develops towards its social function (Vygotsky & Luria, 1994), which is, in other words, the "instrumental function" marked in the developmental changes inwards (Vygotsky, 1997b) as shown in Figure 1 below.

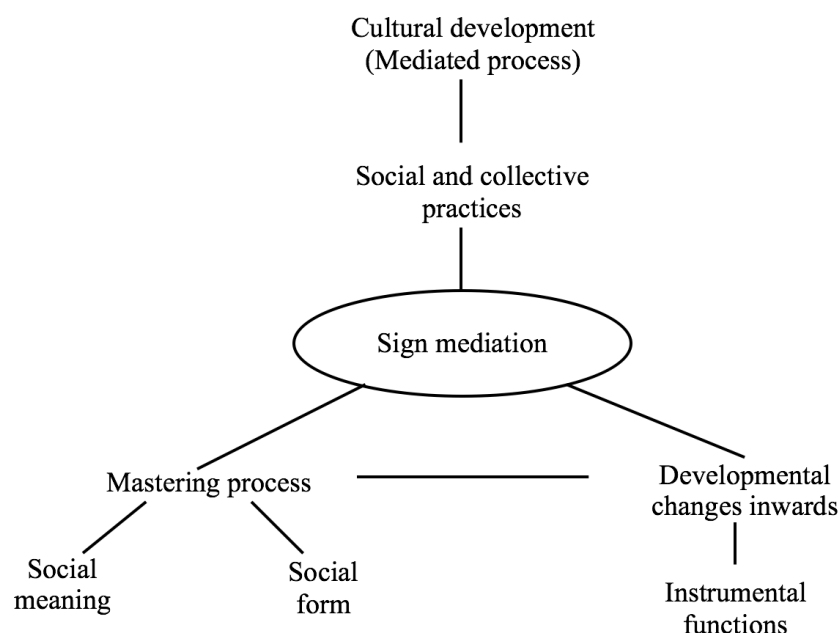


Figure 1. Vygotsky's theorization of sign mediation

Additionally, it is important to mention that not every sign is meaningful in a child's operation. A child is usually inclined to engage in social processes that are aligned with his or her logic and interest (Vygotsky & Luria, 1994). That means the meaning of a sign needs to be socially understandable and have shared sense for a child. Not every function of a sign can be transferred into the inner function. It takes a long time to establish a new system of thinking, during which many functions of the sign only exist in the form of external operations (Vygotsky & Luria, 1994). This is a complex process of constructing the instrumental functions mentally, which is dependent upon how a child participates into the social practices and his or her way of taking advantage of the social means. The present study was interested to investigate the sign-mediated process of scientific learning during family play practices and to discuss how effective the sign mediation is in achieving a child's changes in thinking around certain scientific concepts.

A cultural-historical conception of a child's imaginary acts in play

Based on Vygotsky's (this issue) conception of play, there is a divergence between the fields of meaning and vision, because meaning begins to dominate acts with real objects. At a very early developmental period, children's behavior has not yet become separated from direct perception and external action (for instance, practically operating the objective world). However, at the preschool age, their behavior under an imaginary situation in play is apart from the immediate functions of the objects, and their thought begins to depart from the concrete situation and to work within the field of meaning (Vygotsky, 2005). Vygotsky (this issue) argues that it might be difficult for a child in preschool age to abstract meaning from an object directly, but in play, for example, they are able to use a stick to be "a pivot for severing the meaning of horse from a real horse" (p. 13). Significant here is that substitute objects/actions are signified and formed to have the semiotic meaning, through which other objects/actions are represented and their real meaning is severed, and this potentially leads to new forms of behavior.

For example, at the moment when a stick turns into a horse, it acts as a placeholder of the horse that a child pretends to act on in an imaginary situation. It is functionally served as the "pivot"

for separating the meaning of “horse” from its real referent. We can say that the riding action itself also takes the role of a “pivot” because it makes the child imagine and play with the meaning of the “horse”. When the object dominates, meaning is in relation to it, but is covered and unable to be realized. However, when meaning predominates, the object is invisible but can be substituted by means of the “pivot” through play. There exists the “pretend” sign with its “real” meaning during the play activities (van Oers, 1999). The valuable learning process can be identified when children consciously deal with the relationship between the “pretend” signs and their “real” meanings (that means the referred meaning) in play (van Oers, 1999). Here the “pretend” sign seen through the substitute objects/actions is worked as the mediator, which regulates children’s “internal processes in external action” (Vygotsky, this issue, p. 16). Play has its mediated role in fostering children’s inner processes of severing the meaning from direct perception (Nicolopoulou, 1993). It supports the process of representation, where children may regulate their meaning making through the “pretend” sign.

In play, a shared imaginary situation can be created “if all the players are able to develop a common understanding or common practice that allows them to enter, exist, develop or reject the themes or objects that are offered between children” (Fleer, 2010, p. 81). The collective imaginary play is a unique type of social situation where a child is able to formulate sustained shared thinking (Siraj-Blatchford, 2007) around the new meanings for the “pretend” signs. In collective play, a great deal of effort is needed to continually upgrade and develop a common understanding of the meanings created collectively. This is a meaningful process of considering the social elements individually to attain the social consciousness through a collective subject (Lektorskiĭ, 1980/1984). This paper reports on the findings of a study, which reveals the mediation through play during a child’s scientific learning, where the collective interactions between the parents and the child have been carefully examined.

Study overview

Participant recruitment: The case study presented in this paper is drawn from the broader research project that examined young children’s everyday family play practices and their links to concept learning. The participants were randomly recruited through the early childhood educators in a public preschool in the urban area of a medium-sized city (Taiyuan) in Mainland China. The criteria for recruitment were families with children between 3–5 years old who are the only child in each family and whose parents received education for an average of 16 years. In addition, agreement to participate in a study that drew upon digital video observations and interviews across the everyday life of the child was needed. The parents were informed about the longitudinal case study being conducted over two different research periods, which constituted approximately 30 hours of data per family. In the overall study, two families who met the criteria and agreed to participate in this study were selected.

Background of the focus family participants: The data referred to here relates to Yao’s family, including Yao—who was aged 3.3 years in Observation Period 1 and at 4.2 years in Observation Period 2—and his parents. Yao’s home is a newly built flat in a high building located in a small residential area during the first observation period. During the second observation period, they moved to a tube-shaped apartment inside Taiyuan Normal University, which is within walking distance of the childcare centre. The play area was arranged near a bookshelf in their bedroom, and the toys were separately placed in plastic boxes so that they could be easily found. Both parents hold higher education qualifications. The father (Li) is a lecturer teaching English

language in Taiyuan Normal University, and the mother (Shu) works for a language training school.

Data gathering procedure: Yao's play-associated activities and practices were video-recorded over two different research periods, and in total, 18 family visits were conducted based on the parents and child's convenience. Two cameras were set for documenting children's play at the family home. A camera on a tripod was fixed near the play settings for capturing the general family play activities. Another camera followed the child as he or she participated in family set play. Two cameras were used to capture long shots of a child's family play and simultaneously more detail form certain play activities (to provide different views on the same play activity). A disposable camera was left for the parents to videotape and/or photograph the child's everyday family play and/or learning that they valued. The study reported in this paper featured the data from Yao's family including 21 hours of video observations over five visits with each visit lasting around 1.11–1.90 hours (M=1.69 hours), another 11 visits made after 10 months with each visit lasting around 0.45–2.08 hours (M=1.14 hours), as well as 3.06 hours (M=1.53 hours per observation period) of parent interviews when they were showed the video clips made through the family observations. Additionally, parents as the co-researchers in this study took 11.6 hours of videos (51 clips) of Yao's everyday family activities. These videos were taken in a natural family context, focusing on the activities parents valued as importance for Yao's development. In total, 35.66 hours of video data were collected.

Data organization and analysis: Video data were imported into iMovie (standard with Macs) and classified by time sequence. A research protocol for each videotape and associated photographs was developed, which followed the chronological order for each hour of visual data collected. The data were then segmented into concept-learning episodes (e.g., when children were reading about particular concepts with their parents, or participating in parents' arranged learning practices such as counting blocks and recognizing materials), imaginary-play episodes (e.g., when children were roleplaying and creating their imaginary situations, which are featured in changing the meaning of objects and/or actions), and episodes about the imaginary exploration of scientific concepts (e.g., when children were imaging particular scientific phenomenon such as Earth revolution and rotation, and/or acting out the scientific meaning or rules within an imaginary situation).

By using a dialectical-interactive approach (Hedegaard, 2008), the data were analyzed according to three main levels of interpretation: *common sense interpretation* (some striking concept learning through parents' supported imaginary play stood out), *situated interpretation* (analysis involved the examination of the conceptual patterns such as imagination built for play and learning), and *thematic level* (the rigorous examination of the interpretations across family play practices and activities for finding the thematic interpretation using cultural-historical conceptualization). The details of the schemes used for the interpretation at thematic level will be explained in following section. In a qualitative approach to researching families, where a cultural-historical framework is adopted, validity is achieved through documenting how the researcher is positioned in relation to the participants during data gathering. A cultural-historical study seeks to capture holistically the child's intentions, the play conditions, the family interactions and practices, and the role the researcher took during data gathering. As such, all data were coded in relation to the actions of the researcher and analysis considered the relations between the researcher and researched persons.

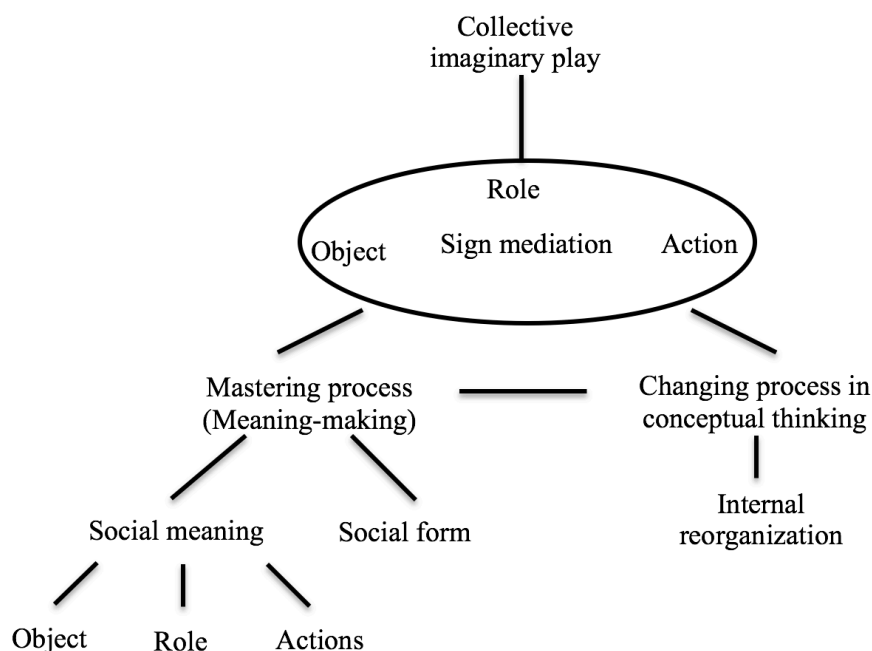


Figure 2. The Analytical Schema of the Sign Mediation during Play

This paper draws upon a cultural-historical conceptualization of sign mediation and play (especially the concrete–abstract relations in play). The data analysis was thematically structured by means of specific cultural-historical concepts and the relations between them (see Figure 2). It is important to note that when investigating play from a cultural-historical perspective (Vygotsky, this issue), the following key points need to be considered in the analysis:

- Formulate an imaginary situation
- Use “pivot” (served as the “pretend” sign) to represent the meaning of other objects/actions
- Take on and perform the roles of other people

In following Vygotsky’s (this issue) theorization of play, Bretherton (1984) explains the abstraction of meaning in play through the development of event representation, which is marked by the increase in the number of roles and the complexity of the order and coherence of actions, as well as the decrease in the dependence on veridical props. Role, action, and object representation are seen as separate dimensions of symbolic play, but they are associated with each other in an integrated system of event representation (Bretherton, 1984). Van Oers (1999) has suggested that play, as a semiotic activity, is featured in children’s consciousness and reflects the “real” meaning represented by the “pretend” sign. A developed cultural-historical understanding of play includes an imaginary situation of new “pretend” signs which are created and developed through their external form (e.g., object, action, and role) with new meanings and as new structured relation (see Figure 2).

When considering the sign-mediated process of internalization, Siraj-Blatchford (2007) has shown that pretend roleplay contributes to the “ ‘inter-acting’ with pretend others (increasingly acknowledging ‘their’ perspective)” (p. 17) and the internalized object/action representations. The crucial role of play (specifically the socio-dramatic play) mentioned here is evident in the increasingly sophisticated collaborations between players, where they continually develop their shared thinking around the meanings represented. This is, in nature, the socially supported

process of sign mastering (considering the manipulation of substituted objects) and the inner process of conscious thinking around and through the pretend signs. In play (especially collective play), children respond to this kind of mediation by manipulating the pretend sign in its social form (socially accepted forms of representations) and mastering its meaning (socially shared senses of representations). This is simultaneously seen through the sign-mediated changes in meaning-making, which is developed during the continuous internal-reorganization (see Figure 2).

How Yao experienced sign mediation of his learning through certain concepts during play is presented in the following sections, where we describe Yao's everyday explorations in play and theorize the concept of pretend sign and its role in learning through play in his family. This will contribute to a new understanding of the role of play in supporting concept learning.

An overview of Yao's everyday family learning and play

In this section we give an overview of the findings of this study in relation to both the child's intentions and initiatives and the parents' perspectives on play and learning. The focus of the analysis presented is from two observation periods (January and November of the same year). The results of this study indicated that the parents highly valued Yao's learning. According to the outcomes of the interview and the observations made, the parents valued learning in the general areas of maths (e.g., classification, differentiation), science (e.g., the three states of water, the alternation of day and night, Earth rotation and revolution, etc.), and social rules (e.g., friendship, humility). In the context of the importance placed on education by most Chinese families (Chang, 2003; Roopnarine & Johnson, 2001), where home instruction in academic learning is commonplace (e.g., Chang, 2003; Chua, 2011), there were differences between the observation periods in terms of the role of play for supporting academic learning at home. During Observation Period 1, the family mainly focused on instructing Yao in mathematics (Hao & Fler, 2016). However, during Observation Period 2, the parents recognised that Yao was still young and not yet able to grasp the complexity of many scientific concepts, but they believed it was important to help Yao begin to think about some concepts. From the parents' perspective, Yao should be supported with his ideas or logic about particular concepts, even though they were different from the parents' understanding. For example:











Yao is still young and cannot formulate the complex scientific concepts, but he needs to start his thinking through these concepts He already had his ideas and always asked us questions about what he interested. For example, he asked why people float when losing weight. (Observation Period 2: Interview, Shu)

To explain this change in beliefs about Yao's scientific learning and parent-child interactions shown in everyday family observations, we examined the notable differences in parents' interactive approaches between Observation Period 1 and Observation Period 2. In Observation Period 1, the parents usually created special moments at home where the focus was on instructing Yao on specific concepts (see Table 1). For example, the mother placed the toy bowls ready on the *tatami*, and then asked Yao to not only knock down the bowls but also recognize the shape (in a triangle) made by the bowls and count how many have been left after a hit (as shown in the second row in Table 1). Especially when sitting together to read a book, Yao was demanded to learn specific concepts in maths, geography, literacy, and so on.

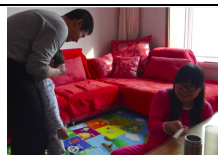
The parents' focus was in relation to what they valued, rather than what might be of interest to Yao. In Table 1, we show both the parent-initiated learning activities (column 1) and what Yao was doing at that moment (column 3). The examples given in Table 1 show what the parents usually planned and organized, such as recognizing different shapes of the blocks. What we found, and what is shown in column 3 is Yao's intentions focusing more on playing with an imaginary mobile phone (e.g., calling someone using a notebook as the mobile and charging a mobile represented by a box), or tuning the block-counting activity into an imaginary train, as was observed during the parent-initiated learning practices. The results shown in Table 1 indicated that parents' initiated activities were usually in contrast to what Yao was interested in doing. These were usually observed in everyday family practices that the parents' initiated, and the child's interests were often shown in separate directions. The parents mentioned during interviews that Yao usually did not pay attention to their words and he easily transferred his interests to other activities. For example:

Yao did have some problems in paying attention to what we are saying . . . We often teach him the concepts. Maybe sometimes we expected him to think following our thinking mode, and he preferred to have his own ways to do his activities. (Observation Period 1: Interview, Shu)

Table 1
Main family practices during Observation Period 1

Parents' initiatives/intentions	Photo Examples	Yao's initiatives/intentions	Photo Examples
Playing drum to recognize the number of knocks		Playing drum at will Calling someone using an imagined mobile (a note book)	
Counting the number of bowls Recognizing the shape made up by the bowls		Playing with the researcher's camera Charging the imagined mobile (a box)	
Recognizing the squares from the blocks Counting the blocks		Imaging a long train made by the blocks was moving away Playing with the researcher's camera	
Reading books (geographic names, simple math, angry, four seasons)		Playing with the toys under the table Catching the imagined mobiles	
Colouring different flowers in a painting book		Asking to play imagined mobile	

Recognizing the different materials made for the cups



Asking to eat a lollipop



It should be noted that, in the recent Chinese literature, playful learning has been identified as a significant area of research, due in part to the introduction of play-based curriculum (Pan, Wang, & Li, in press). However, what is known about families in China is that learning, rather than play, is a valued family practice (Chang, 2003). The differences between the two observation periods reflect the ongoing debates about playful learning that has recently emerged in the literature (Pan, Wang, & Li, in press). In Observation Period 2, the parents changed their ways of planning and organizing Yao's everyday learning and play at home. They paid more attention to Yao's interests, and used this consciousness to 1) intentionally set for Yao's interested play; 2) participate in, and expand his play to include opportunities to learn concepts; and 3) create playful instructional situations, usually through demonstrations verbally and nonverbally based on what Yao was interested in at that time (see column 1 in Table 2). Table 2 shows the examples of the main play themes that were of interest to Yao (rocket play; Earth and space play). Rocket play was the dominant activity of Yao during Observation Period 2. This play was observed each day during the data gathering.

Rather than setting up special instructional activities, during Observation Period 2 the parents used Yao's play to teach him complex scientific concepts. As is shown in column 1 of Table 2, the parents supported Yao's rocket play, especially the father, who not only paid attention to setting up Yao's everyday rocket play, such as making up the rocket model including a launching tower, but also actively involved himself in Yao's imaginary play. For example, Yao's everyday rocket play made the parents start to pay attention to his play interest, so that they bought the rocket model online and constructed it together with Yao to set for Yao's modelling of rocket launching (shown in the first row of Table 2). Sometimes, Yao also acted as a rocket to be launched into space, and the parents, especially the father, usually participated in Yao's rocket play and extended it by introducing new play themes such as Earth-orbiting (see row 2 in Table 2). The parents also intentionally formed new play settings that Yao showed his interest to be involved in to demonstrate or enact the scientific phenomena (such as Earth moving shown in row 3 of Table 2).

In the imaginary play, the parents' preference was to use performances or playful demonstrations to teach Yao new concepts, such as roleplaying the Earth-orbiting. Even though the scientific concepts were complex, Yao was observed to accept the expansion of his play, as was evident in his attentiveness and participation in the developing play theme. Yao also showed his inclination to play a role in parent-initiated playful situations. For example, he actively performed the role of the Earth to move around the sun (acted by the father). These were commonly observed in Observation Period 2 across a diversity of everyday family practices for supporting Yao's learning of new concepts (see column 2, Table 2).

In comparing Tables 1 and 2, it becomes evident that the parents' perspective changed from rote learning and direct instruction to considering Yao's intentions and interest in guiding learning inside the imaginary play. For instance, during the interviews, the mother also explained this change in their practice:

We gradually found that Yao was easy to pay attention to our playful ways, the performances. We often use the exaggerated performances, sometimes demonstrations







to make him understand the concepts shown in a book. These are much better than read directly through the concepts. (Observation 2: Interview, Shu)

The overall data set shows that Yao's parents began to be conscious of Yao's imaginary play and the value of joint imaginary play in supporting Yao's concept learning during the second observation. For example, the parents commented that Yao keeps his rocket with him at all times, including during his sleep, and as mentioned in the interview, "Yao must live with his rocket". The parent interviews also indicate that Yao's parents are more consciously aware of how important it is to pay attention to Yao's imaginary play and use it to support Yao's understanding of certain concepts, which is difficult for Yao to grasp through direct instruction (as shown in their active play engagement in Table 2). Yao's imagining and his exploration in an imaginary situation were shown to be supported in Observation Period 2 where the parents consciously organized play that followed Yao's interest in space.

Through the parents' closer attention to Yao's interest in imaginary play, they found that they could contribute to both Yao's learning and his imaginary play. They supported his rocket play by extending his understandings of rocket operations, and they also initiated other related play themes, such as the Earth moving around the Sun. This was especially pronounced through the significations of objects, such as the watermelon toy shown in Table 2, and through playful demonstrations, such as the pretend signs that were used for demonstrating Earth rotation and revolution. Compared to the first observation period, Yao showed more active playful explorations and simultaneously, his parents presented their approaches to mediating Yao's concept learning more successfully when they could collectively play with Yao in a shared imaginary situation. However, to understand the significance of this change in practice for Yao's learning through imaginary play, the following section will focus on an interpretation of how the pretend signs created during collective family play contributed to the mediation of Yao's scientific learning in more detail.

Table 2
 Main family practices during Observation Period 2

Parents' initiatives/intentions	Photo Examples	Yao's initiatives/intentions	Photo Examples
Making up the rocket models		Making up an imagined rocket or parts of it Modeling rocket launching	
Roleplaying of Earth-orbiting		Acting as the rocket to be attracted by the Earth	
Demonstrating Earth rotation and revolution		Acting as the Earth	

Modeling the full process of rocket launching		Modeling the moment of rocket launching Counting down	
Asking questions about Earth gravity		Watching rocket launching Playing the launching process	
Demonstrating the alternation of day and night		Participating in the demonstration	

Sign mediation of scientific learning through play

As has been noted by Kravstov (2006), an imaginary situation created in play acts as a bridge for learning. In this study, as shown in the previous section, collective play engagement at home had an effective role in mediating a child's concept learning. The mediation through play was revealed as Yao and his parents engage together in the shared imaginary situations. Specifically, they tried to exactly perform the pretend roles and give new meanings to the objects/actions, which were used as "pivots" to objectively support the meaning-making process. According to Vygotsky's (1997a) theorization of signs in mediating a child's cultural development, when we try to illustrate children's play, especially collective play within their social practices, it is possible for us to identify and understand the sign-mediated process through play.

The pretend signs were found and identified in this study to specifically depict the child's social process and its mechanism in the context of family collective play. During family play, the pretend signs were not predetermined but gradually formed and became more sophisticated when continually shared between the child and parents. The diversity of signs existing in play were shown through the pretend roles and the substitute objects to represent meaning. This study found that the pretend signs could be introduced by both the child and the parents into a shared imaginary situation where they are able to fulfill the particular function of the "signs" to realize its meaning in a sense field. This could be understood by illustrating the different forms of pretend signs that were created, shared and developed during a collective imaginary play. The meanings they represented and the relations between them were found and shown in a holistic system of event representation. These could be specifically depicted in the form of extended performances, playful demonstrations and redemonstrations.

Pretend signs shown through extended play performances

According to Example 1—parents' joint imaginary play of Earth-orbiting shown in Table 3—an imaginary situation was initially created by Yao as he played with his father. Yao was in the role of a rocket and acted in accordance with the rules for operating a rocket, that is, he started to act and think from the perspective of being the rocket. He is no longer Yao, but the rocket going away from the Earth (the role expected to be played by his father in this play) when climbing into the bed. We may say that he performed the role of a rocket, which could be seen as the pretend sign to be understood by the father (see Circle 1 in Figure 3). Being in the shared

imaginary situation, it is possible for the father to read the meaning of the pretend sign shared by Yao. Simultaneously, the father could also develop this signification by broadening its meaning such as suggesting to show Earth-orbiting (see Circle 2). The new sign shown through the circling movement was available for Yao and was handled quickly as Yao's pretend action. One possible reason is that it closely connected to Yao's imaginary thinking where he drew upon the idea of making the rocket be attracted by the Earth.

The basic structure of this roleplay (performing the role of a rocket and acting its movement) was carefully captured by the father, so that the new sign (for doing Earth-orbiting) could be naturally introduced to direct Yao's understanding of the traveling of a rocket in space. The mother then joined in this play by acting as the moon. Her play participation continually broadened the signification of the rocket, such as the new representation of doing moon landing by walking toward the mother (see Circle 3). The new representations that parents initiated largely extended the significance shown through the collective family play.

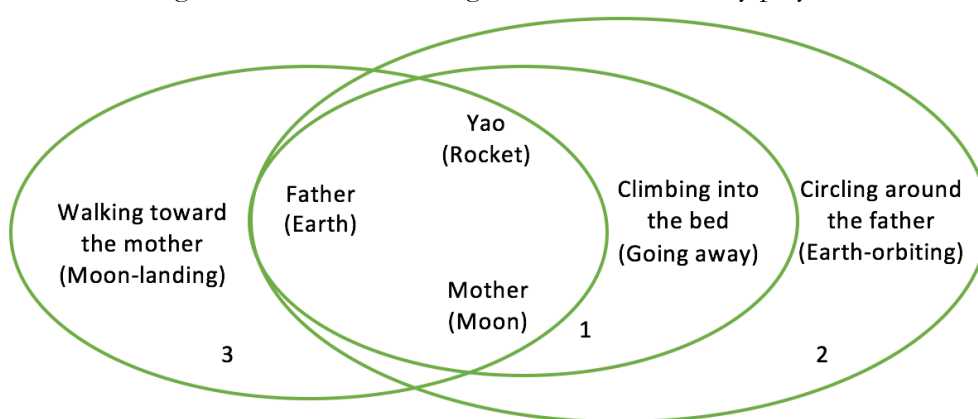


Figure 3. A System of Pretend Signs Mastering in Performance of Earth-orbiting

There exists a mediating process through a holistic system of pretend signs, which is shown in Figure 3 in dynamic relations between the roles (e.g., the Earth, the rocket, and the moon) and the actions (e.g., circling movement, walking towards the mother) performed. These pretend signs were synthesized through the social form for sharing the meanings they represented (see Figure 3 and Table 3). According to Vygotsky's (1997b) explanation of the signification in human beings' mental development, in the synthesized system, what matters is the social process for sharing the signs and making them work holistically to form the meaning that can be socially read and understood.

In this study, when Yao climbed into the bed and asked his father to catch him, he expressed his inclination to let his father pay attention to this "pretend sign" (shown here through Yao's initiated act). At that moment, Yao's social need was revealed as interacting with his father, which means to include this social form into his activity. According to a cultural-historical view, this indicated the possibilities of the changes in the direction of Yao's behaviors and determined the future route leading to his acquisition of a social function. When the circling movement was introduced for showing Earth-orbiting, the performance of the rocket could be extended, which could be seen with a more complex representation of meaning. The "rocket" did not just go away, and then was attracted by the "Earth". It had its rule of doing Earth-orbiting due to the Earth's gravity, and this was represented through the actions related to the roles, which was largely supported by the shared imagination in this collective family play. The pretend sign was now embedded with a more sophisticated social meaning for representing the Earth-orbiting.

In other words, we may say that Yao's playful behavior reveals its social characteristics during his collective interactions with his parents in a semiotic way. In line with Vygotsky's theoretical conception of the social source of a child's development in higher mental functions, the process of mastering and using the pretend signs (see Table 3), which was featured in Yao's extended performances as seen through the social form of the signs, was crucial for the mediation of Yao's scientific conceptualization around the traveling of a rocket. The parents' collective involvement plays an important role in making the sign mastering available to Yao. Only when the child is able to catch the meaning of the sign through its social form, can there be potential to work on the child's imagination so as to form new logic of the rules for operating the rocket.

Table 3

Example 1 - Pretended signs for earth-orbiting

Transcripts	Pretend sign	Social meaning	Social form	Inclinations for self-rearrangement
Yao: Dad, catch me! (Yao climbed into the bed) Father: You cannot be attracted (by the Earth). Quickly come here! He said I am the Earth and can attract him. He is the rocket.	Yao climbed into the bed	A rocket is going away from the Earth (the father)	Initiative action (Yao)	Sharing action
Father: Rocket, I attract you and you move around dad. Earth-orbiting, Earth-orbiting (Father held the hand of Yao and made him move around him) ...	Yao circled around the father	The rocket is doing Earth-orbiting	Extended performance	Broadened imagining
Mother: You are now the rocket and your dad is the Earth. Please be aimed for me – the moon now. Father: Yes, then, for example, (you are going to be) fired at that planet. Mother: Fire at me – the other planet. Quickly, launch it now. Wu... (Yao held father's hand and walked toward his mother.)	Yao walked toward the mother	A rocket is going to land on the moon (the mother)	Extended performance	Broadened imagining

Pretend signs shown through playful demonstrations

Another case example was featured in the critical process of creating and recreating the pretend sign to make it exactly show the real law of the Earth's rotation and revolution (see Table 3). The parents initially set the roles and imbued new meaning into the watermelon ball, as the Earth. When asked to demonstrate the Earth's rotation and revolution, Yao held the ball and kept doing circling movements around his father (the sun). Yao explained that he was doing Earth-orbiting. For Yao, he created his own imaginary situation of being a rocket to do Earth-orbiting. When Vygotsky's concept of "pivot" was used as an analytical device to examine the playful mediation, the watermelon ball could be understood here as the pivot introduced by the parents to objectively support their expected signification of the scientific meaning. Yao at first did not respond to this signification (see Circle 1 in Figure 4). It might be that he mixed the representation that the parents just introduced with the one for showing Earth-orbiting. For the parents, Yao still did not clearly grasp the representation of being the Earth, so that they tried to instruct Yao on the new representation by critical questioning his own imagining (see Table 4). At this critical moment, Yao showed his inclination to reinterpret the meaning, and it seems that he differentiated his representation from the previous one (for showing Earth-orbiting) when changing to move from the opposite direction (see Circle 2, Figure 4). Based on Vygotsky and

Luria's (1994) theorization of sign mediation, the critical situation provided the opportunities for cooperation, which could be specifically seen here as a social way for clarifying the meaning-making process.

During this play moment, Yao tended to play and to show his pretense of this play. However, this scientific imagination is difficult to be completed by Yao himself. As has been mentioned by Vygotsky and Luria (1994), under certain conditions, a child may not attain the purpose by him/herself. That is, "the plan of the solution is, in the main, ready although beyond the limits of his own action" (p. 117). The new imaginary situation shared by the parents needs to be achieved through the imagining of the Earth's rotation and revolution. Yao showed his tendencies to act as the Earth, but he cannot attain this only by his own imagining. That is why the meaningful signification is so important here, which is seen from a cultural-historical perspective as the creation and use of signs (Vygotsky, 1997a). Parents' play participation is crucial for the signification, because the new signs should firstly be used by the parents as the means for the child to acquire the social actions. Only then will the pretend sign have meaning for the child. This obstacle was noted during the parent-child interactions in play. This resulted in the mother's shared demonstration (e.g., moving around the father and rotating the ball at the same time), which gave Yao new ways of representing and provided him with new relations with the pretend signs. The changing point of Yao's pretense has been revealed when he started to accept the pretend sign shared by his mother with its social meaning through the simultaneous circling motion around the father and the movement of the ball back and force (see Circle 3). Yao's action in roleplay showed his practice as mastering the sign through imitative actions.

As shown in Figure 4, with the help of the mother's playful demonstration, which could be illustrated as a new system of signification, even though Yao still acted the role as the Earth, he showed quite different actions. Yao's actions suggested that he tried to imagine what his mother had shown to him. It might be that Yao was in his process of mixing his own imagining with what his mother shared with him. From a cultural-historical perspective, through cooperation, a child may confuse his own logic with others' which was absolutely new and foreign to him, but which was in the process of combining into "one syncretic whole" in the child's own way (Vygotsky & Luria, 1994, p. 117). The mother's shared pretend sign (shown here as the Earth-moving demonstration) did provide a new direction of the behaviour for Yao, and this was shown in Yao's process of mastering this social form and to include its social meaning into his way of representation. Based on cultural-historical theorization, the functional meaning of signs is not just in the mastering process, but also in an inner process of building up new connections in the human brain. Yao indicated his inclination to reform his imagining by means of his parents' explanation and demonstration when they were engaging in a shared imaginary situation with Yao. It is manifested that Yao tried his best to explore the exact representation of Earth rotation, and at last it seems that he tested the meaning of Earth rotation by turning himself around (see Circle 4). The father's exemplification (e.g., "For example, dad will stand up and move around myself.") seen here, as a form of sign mediation, was crucial to orient Yao's self-exploration of the meaning through exact representation.

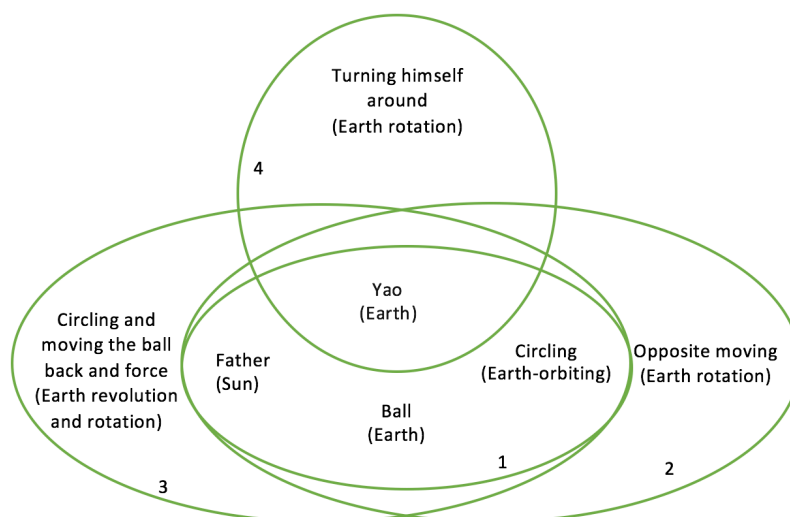


Figure 4. A System of Pretend Signs Mastering in Playful Demonstration of Earth moving

Even though it is difficult and takes a long time for a child to internally gain a new synthesized mode of thinking, the findings of this study showed that it is possible for a young child to have an experience in exploring certain scientific phenomenon with social support. In Table 4, we can see that through this collective family imaginary play, Yao showed his process of imagining and reimagining as guided by the playful demonstration and redemonstration. The pretend signs featured in the family collective imaginary play have been structured in a holistic system and shared between Yao and his parents. The findings showed how important the pretend signs are to affecting Yao's semiotic behaviours through play. When he was trying to imagine and reimagine his representation of being the Earth using the signs his parents' introduced, the conditions were provided for the development of Yao's potential for conceptual understanding of Earth rotation and revolution. The uniqueness of play, especially the adults' participated collective play, is that a child's socially supported consciousness of certain scientific reality is possible to be realized by means of the pretend signs introduced, tested, and used when players engage in the shared imaginary situation.

Table 4

Example 2 - Pretended signs for Earth rotation and revolution

Transcripts	Pretended sign	Social meaning	Social form	Inclinations for self-rearrangement
Mother: How does it (the Earth) rotate (on its axis) and at the same time... Father: (Simultaneously) For example, dad is the sun. How does it make the rotation and revolution? (Yao held the ball and moved around his father) What are you doing? Yao: Earth orbiting.	Yao held a watermelon ball and circled the father	Earth rotation or revolution may be the same as the Earth-orbiting	Playful demonstration (Yao)	
Mother: This is Earth orbiting? (Mother and father laughed) You are the Earth and your dad is the sun. You were doing Earth revolution. How does it rotate on its axis? Father: (Simultaneously) How does it	Yao held the ball and made an opposite movement	The Earth moves from opposite direction to do Earth rotation	Re-demonstration (Yao)	Reimagining

rotate on its axis? Show us. (Yao moved around Li from the opposite direction.)

Mother: Earth rotation means moving from the opposite direction? (They all laughed) Baby, let mum tell you. Making a rotation means when you move in a circle you also rotate around yourself on one side. Make sense? This is the rotation on its axis. (The mother made the ball spin and she turned around the father simultaneously)

The mother	The Earth	
moved around	rotates on its	Playful
the father and	axis and at the	demonstration
rotated the ball	same time turns	(Mother)
at the same time	around the sun	

Mother: Ok, you show us once again. (Yao held the ball and moved around his father) Rotate on its axis and at the same time revolve around the sun. (Yao held the ball and keep turning around his father) Rotate on its axis and at the same time... The ball also moves around itself. Make it move around itself. (Shu made the demonstration with gestures. Yao held the ball and moved it back and forth when turning around his father.)...

Yao kept	The Earth		
circling around	moves by itself	Re-	
his father with	and turns	demonstration	Reimagining
the ball and at	around the sun	(Mother and	
last moving the	at the same	Yao)	
ball back and	time		
forth			
simultaneously			

Li: Rotate around itself. For example, dad will stand up and move around myself. That is the rotation on its axis. Make sense?

Yao: Dad, dad... (Yao stood up and made a rotation around himself)

Li: Yes, Earth rotation!

Yao turned	The Earth	Re-	
himself around	moves by itself	demonstration	Reimagining
		(Yao)	

Conclusion

The findings of this study contribute to a better understanding of how families create shared imaginary situations where learning is being fostered. Previous research suggests that learning occurs through play, but less attention has been directed to showing how families create the conditions for learning in play. This study showed how one family mediated the learning of concepts not directly visible, through shared imaginary exploration of scientific laws. Learning as a valued family practice in China, was also identified in this study. This study showed how family learning practices that follow the child's interests leads to collective imaginary play by the whole family. Even though the concepts were abstract, and it was not possible to determine the amount of learning, what was evident in this study, was how families could begin to use imaginary play for helping their child to learn scientific concepts valued in China. Therefore, this study has contributed to filling the gap in the literature, by identifying how signs featured in play enable a child to develop his meaning-making during the collectively supported scientific representations. The collectively created imaginary situation was discussed in this study through the parents' participated process of signification, where the pretend signs (in the form of substituted objects/actions and pretend roles) were consciously formed and developed with the help of parents' intentional play engagement. Thus, the child's meaning representation is possible to be collectively supported when the pretend signs are used and shared between the child and his parents.

Family collective imaginary play was revealed in this study as not simply a way of fostering parent-child interaction, but as the sign-mediated process of the child's realistic thinking of

particular conceptual rules. As the study has shown, the collective imaginary play provided the conditions for the child to improve his way of creating and using the pretend signs either by means of continually extended performance or through playful demonstrations. Importantly, this was largely dependent upon how the shared sense of the signs could be realized between the child and his parents to help the child socially work on the meaning represented by the signs.

Based on Vygotsky's theory (1997a), the interpsychological functions can be illustrated when signs are initially formed through the relations between people, and then become individual psychological processes. When play was considered as a sign-mediated process, it is not difficult for us to better interpret its role in the socially supported meaning-making, where the collective subject is possible to be formed in a meaningful process of individualizing actions and learning. The findings suggest that during the process of creating and mastering the pretend signs, a child showed his inclination to rearrange his logic in relation to everyday and scientific concepts, and specifically this potential change in his thinking mode was achieved through the process of broadened imagining and reimagining in play. Analyzing play in this socially supported thinking process gave the possibility for better understanding the sign feature of play in mediating a child's realistic thinking and the special role of play in fostering the internalization of the social function of a sign.

Acknowledgement

The authors would like to sincerely acknowledge the child Yao and his family. The authors are also grateful to Cultural-Historical Research Community for the group support of the writing of this paper.

References

- Anastasiou, L., Kostaras, N., Kyritsis, E., & Kostaras, A. (2015). The construction of scientific knowledge at an early age: Two crucial factors. *Creative Education*, 6, 262–272.
- Bergen, D. (2009). Play as the learning medium for future scientists, mathematicians, and engineers. *American Journal of Play*, 1(4), 413–428.
- Bozhovich, L. I. (2009). The social situation of child development. *Journal of Russian and East European Psychology*, 47, 59–86.
- Bretherton, I. (1984). Representing the social world in symbolic play: Reality and fantasy. In I. Bretherton (Ed.), *Symbolic play: The development of social understanding* (pp. 1–39). New York, NY: Academic Press.
- Bruce, T. (2005). 'Play, the universe and everything!' In J. Moyles (Ed.), *The excellence of play* (2nd ed., pp. 255–67). Maidenhead, United Kingdom: Open University Press.
- Chang, P. Y. (2003). Contextual understanding of children's play in Taiwanese kindergartens. In D. E. Lytle (Ed.), *Play & culture studies: Vol. 5. Play and educational theory and practice* (pp. 277–297). Westport, CT: Greenwood.
- Chua, A. (2011, January 8). Why Chinese mothers are superior. *The Wall Street Journal*. Retrieved from <http://www.wsj.com/articles/SB10001424052748704111504576059713528698754>.
- Cunningham, A. E., Zibulsky, J., & Callahan, M. D. (2009). Starting small: Building preschool teacher knowledge that supports early literacy development. *Reading & Writing*, 22, 487–510. doi:10.1007/s11145-009-9164-z
- Davydov, V. V. (2008). Appendix: From the history of general and child psychology. In *Problems of developmental instruction: A theoretical and experimental psychological study* (pp. 179–198). New York, NY: Nova Science.
- Dockett, S. (1999). Thinking about play, playing about thinking. In E. Dau (Ed.), *Child's play: Revisiting play in early childhood settings* (pp. 28–46). Sydney, Australia: MacLennan and Petty.
- Elkind, D. (2008). The power of play: Learning what comes naturally. *American Journal of Play*, 1(1), 1–6.
- Falco, S. de, Esposito, G., Venuti, P., & Bornstein, M. H. (2010). Mothers and fathers at play with their children with down syndrome: influence on child exploratory and symbolic activity. *Journal of Applied Research in Intellectual Disabilities*, 23(6), 597–605.
- Fleer, M. (2010). *Early learning and development: Cultural-historical concepts in play*. New York, NY: Cambridge University Press.
- Fleer, M. (2013). Collective imagining in play. In I. Schousboe & D. Winther-Lindqvist (Eds.), *Children's play and development: Cultural-historical perspectives* (pp. 73–87). New York, NY: Springer.
- Fromberg, D. P., & Bergen, D. (2006). *Play from birth to twelve. Contexts, perspectives, and meanings* (2nd ed.). London, United Kingdom: Routledge.
- Gaskins, S., Haight, W., & Lancy, D. F. (2007). The cultural construction of play. In A. Göncü & S. Gaskins (Eds.), *Play and development: Evolutionary, sociocultural, and functional perspectives* (pp. 179–202). New York, NY: Lawrence Erlbaum.
- Gustavsson, L., & Pramling, N. (2014). The educational nature of different ways teachers communicate with children about natural phenomena. *International Journal of Early Years Education*, 22(1), 59–72. doi:10.1080/09669760.2013.809656
- Hao, Y., & Fleer, M. (2016). Creating collective scientific consciousness: A cultural-historical study of early learning about Earth and space in the context of family imaginary play. *Asia-Pacific Journal of Research in Early Childhood Education*, 10(2), 93–124.

- Hedegaard, M. (2008). Developing a dialectic approach to researching children's development. In M. Hedegaard & M. Fleer (Eds.), *Studying children: A cultural-historical approach* (pp. 30–46). Maidenhead, United Kingdom: Open University Press.
- Hedegaard, M., & Fleer, M. (2013). *Play, leaning and children's development: Everyday life in families and transition to school*. New York, NY: Cambridge University Press.
- Kennedy, A., & Barblett, L. (2010). Learning and teaching through play: supporting the Early Years Learning Framework. *Research in Practice Series*, 17(3), 1–16.
- Kravtsov, G. G. (2006). A cultural-historical approach to imagination and will. *Journal of Russian and East European Psychology*, 44(6), 19–36.
- Lektorskii, V. A. (1984). *Sub'ekt, ob'ekt, poznanie* [Subject, object, cognition]. Moscow, Russia: Progress Publishers. (Original work published 1980)
- Ljung-Djårf, A., Magnusson, A., & Peterson, S. (2014). From doing to learning: Changed focus during a pre-school learning study project on organic decomposition. *International Journal of Science Education*, 36(4), 659–676. doi:10.1080/09500693.2013.822604
- Moyles, J. (2005). Introduction. In J. Moyles (Ed.), *The excellence of play* (2nd ed., pp. 1–12). Maidenhead, United Kingdom: Open University Press.
- Nicolopoulou, A. (1993). Play, cognitive development, and the social world: Piaget, Vygotsky, and beyond. *Human Development*, 36(1), 1–23.
- Pan, Y., Wang, X., & Li, L. (in press). Early childhood education and development in China. In M. Fleer & B. van Oers (Eds.), *International handbook on early childhood education*.
- Pelegrini, A. D. (2009). Research and policy on children's play. *Child Development Perspectives*, 3(2), 131–136.
- Roopnarine, J. L. (2011). Cultural variations in belief about play, parent–child play, and children's play: Meaning for childhood development. In A. D. Pellegrini (Ed.), *The Oxford handbook of the development of play* (pp. 19–37). United Kingdom: Oxford University Press.
- Roopnarine, J. L., & Johnson, J. E. (2001). Play and diverse cultures: Implications for early childhood education. In R. S. Reifel & M. H. Brown (Eds.), *Advances in early & day care: Vol. 11. Early education and care, and reconceptualizing play* (pp. 295–319). New York, NY: JAI.
- Samuelsson, P. I., & Calsson, A. M. (2008). The playing learning child: Towards a pedagogy of early childhood. *Scandinavian Journal of Educational Research*, 52(6), 623–641.
- Sikder, S., & Fleer, M. (in press). The relations between ideal and real forms of small science: conscious collaboration among parents and infants-toddlers. *Cultural Studies of Science Education*.
- Siraj-Blatchford, I. (2007). Creativity, communication and collaboration: The identification of pedagogic progression in sustained shared thinking. *Asia-Pacific Journal of Research in Early Childhood Education*, 1(2), 3–23.
- Siry, C., & Kremer, I. (2011). Children explain the rainbow: Using young children's ideas to guide science curricula. *Journal of Science Education and Technology*, 20, 643–655.
- Thulin, S., & Helldén, G. (2011). Opening doors for learning ecology in preschool. In N. Pramling & I. P. Samuelsson (Eds.), *Educational encounters: Nordic studies in early childhood didactics* (pp. 65–85). New York, NY: Springer. doi:10.1007/978-94-007-1617-9
- Trawick-Smith, J. (2009). *Science in support of play: The case for play-based preschool programs*. Center for Early Childhood Education White Paper. Retrieved from www.easternct.edu/cece/files/2014/06/TheCaseforPlayinPreschool.pdf
- Trawick-Smith, J. (2012). Teacher–child play interactions to achieve learning outcomes: Risks and opportunities. In R. C. Pianta, W. S. Barnett, L. M. Justice, & S. M. Sheridan (Eds.), *Handbook of early childhood education* (pp. 259–278). New York, NY: Guilford.
- Ugaste, A. (2005). *The child's play world at home and the mother's role in the play* (Doctoral dissertation). University of Jyväskylä, Finland.

- van Oers, B. (1999). Teaching opportunities in play. In M. Hedegaard & J. Lompscher (Eds.), *Learning activity and development* (pp. 268–290). Denmark: Aarhus University Press.
- van Oers, B. (2013) Is it play? Towards a reconceptualisation of role play from an activity theory perspective. *European Early Childhood Education Research Journal*, 21(2), 185–198. doi:10.1080/1350293X.2013.789199
- Vygotsky, L. S., & Luria, A. (1994). Tool and symbol in child development. In R. van der Veer & J. Valsiner (Eds.), *The Vygotsky reader* (pp. 99–175). Cambridge, United Kingdom: Blackwell.
- Vygotsky, L. S. (1994). The problem of the environment. In R. van der Veer & J. Valsiner (Eds.), *The Vygotsky reader* (pp. 338–354). Cambridge, United Kingdom: Blackwell.
- Vygotsky, L. S. (1997a). Genesis of higher mental functions. In R. W. Rieber (Ed.), *The collected works of L. S. Vygotsky Vol. 4: The history of the development of higher mental functions* (pp. 97–119). New York, NY: Plenum.
- Vygotsky, L. S. (1997b). The instrumental method in psychology. In R. W. Rieber & J. Wollock (Eds.), *The collected works of L. S. Vygotsky Vol. 3: Problems of the theory and history of psychology* (pp. 85–90). New York, NY: Plenum.
- Vygotsky, L. S. (1997c). The problem of the development of higher mental functions. In R. W. Rieber (Ed.), *The collected works of L. S. Vygotsky Vol. 4: The history of the development of higher mental functions* (pp. 1–26). New York, NY: Plenum.
- Vygotsky, L. S. (2005). Appendix. *Journal of Russian and East European Psychology*, 43(2), 90–97.

Authors

Yijun Hao is a current PhD student in Early Childhood Education at Monash University, Australia. Her research interests include: concepts formation, play, family play, and abstract thinking, with special attention on young children's development of concepts associated with their engagement in imaginary play.

Correspondence: yijun.hao@monash.edu

Professor Marilyn Fleer holds the Foundation Chair of Early Childhood Education at Monash University, Australia, and is the immediate past President of the International Society for Cultural Activity Research (ISCAR). Her research interests focus on early years learning and development, with special attention on pedagogy, play, culture, science, and design and technology.

Correspondence: marilyn.fleer@monash.edu